[33] Because the non-specific packet-bearing wavelength is regenerated at each node and travels the entire mesh branch, it is possible for each distribution node along the mesh branch to have multiple cross-connective branches going to, and coming from other nodes. This multi-entry and multi-exit concept provides the basis for a highly redundant mesh-like node distribution architecture that provides multiple access paths for the customer's packets because the packets are wavelength independent. Packets can be assigned to a specific wavelength at each distribution node to avoid incoming wavelength crashes at a particular node. This drives the complexity and decision-making requirements of the optical network down to the distribution node level, increasing the complexity of each node and its cost, but the costs of all-optical add-drop multiplexers (ADMs), switches and routers are dropping rapidly and this will only increase their suitability for this application over time.

[34] This local access all-optical routing and distribution architecture also requires a dedicated control layer that is independent of the transmission layer and is itself highly robust. The control layer can be based around a dedicated optical channel as is known in the art or more preferably via an alternative technology that is not dependent on the same weather limiting conditions such as land-lines or RF/cellular systems as is taught in the prior art. The low data-rate control layer communicates with each distribution node via a broadcast approach for down-stream traffic independently from each node for up-stream traffic. The control layer receives link status, and routing-complete information from each distribution node site. The control layer also allows nodes local to each other to send limited notification of the distribution node customer packet information including header and nearest customer/node location, node routing and packet wavelength assignment to each other. Prior art in the form inter-cellular radio handoffs and AT&T research into semi-autonomous intelligent radio port (IRP) architectures show the possibility for locally autonomous and intelligent radio layer resource management, decision making and hand off capabilities for "cells-nodes" remote from a central office and or vendor POP. Similar broadcast intelligent radio layer resource management techniques and algorithms could be

applied to the mesh architecture defined within this embodiment. The use of a broadcast scenario would allow the tertiary aggregation and distribution nodes (switches), to respond to header information being broadcast down-stream from the network (secondary aggregation node) in the fastest possible time and sets up a storable "linked" switch configuration for up-stream return path for faster packet-switching response until that customer circuit is disconnected. Such an arrangement allows the ganged optical switch configuration, which can be associated (and stored within the look- up table) with the current customer circuit address until the circuit is disconnected. The individual aggregation and distribution nodes can be readied to be reconfigured (via the down-stream radio broadcast information) in preparation for the packet arrival coming through the network and as well as the return path up-stream.

[35] A critical element of above wavelength routing and switching concept is the easy disassembly and re-assembly of bundled wavelengths commonly referred to as WDM or the more complex DWDM. For wavelength routing to occur, select or multiple wavelengths must be withdrawn from the bundled group, processed, and packets re-directed out of the wavelength for local delivery or re-routing. The remaining packets contained within these demultiplexed wavelengths must then be re-inserted into the proper wavelength channel and multiplexed back into the WDM or DWDM wavelength bundle for ongoing transmission to the next node along the branch.

[36] Many techniques exist for this wavelength demultiplexing process. Fig. 1 depicts several of the known demulitplexing techniques but the demultiplexing process of the present invention is not limited by the techniques depicted in Fig. 1. Fig. 1 (a) shows the use of grating technology to demultiplex a bundle of wavelengths and forward the demultiplexed wavelengths to a variety of paths. Fig. 1 (b) shows the use of fused biconically tapered fiber couplers. Fused biconically tapered fiber couplers are symmetrical devices arranged in a tree structure. A first stage demultiplexes the bundle of wavelengths into two combs. In the example depicted in Fig. 1 (b), there are four wavelengths in the bundle. The first stage consisting of

a single fused biconically tapered fiber coupler that demultiplexes the bundle of wavelengths into two combs of two wavelengths each. The second stage consists of two fused biconically tapered fiber couplers in series with the first fused biconically tapered fiber coupler, each of which demultiplexes the comb used as its input into a single wavelength. Fig. 1 (c) shows the use of electro-holographic crystal technology for demultipexing. In the example used in Fig. 1 (c) there are four wavelengths in the bundle of wavelengths. Four electro-holographic crystals would be used, each crystal demultiplexing or extracting a single wavelength. The electro-holographic crystals in effect become voltage-controlled fiber Bragg gratings (FBGs). Due to their structure, crystals can be employed to direct any wavelength onto any fiber.

[37] Fig. 2 is a schematic block diagram of an exemplary embodiment of a primary distribution/aggregation node (with wavelength selection and node-to-node cross-connect) for the architecture of the present invention. In the exemplary embodiment there are three layers. While described separately in terms of a distribution node and an aggregation node, these two entities (distribution node and aggregation node) together make up the primary distribution/aggregation node of the present invention. The topmost layer, labeled distribution/aggregation routing layer, interfaces with the primary fiber metropolitan ring and the local customer primary distribution/aggregation node via the transport branches, i.e., FSOC/radio mesh architecture of the present invention. The middle layer, labeled local distribution and routing layer, routes specific wavelengths or newly assigned wavelengths containing data packets to or from a customer's premises. The lowest layer, labeled cross-connect layer, handles the direct customer wavelength or packet traffic routing between the local customers via the FSOC, optical or radio transport branches.

[38] Taking the down-stream path first, in the exemplary embodiment depicted in Fig. 2, wavelengths and wavelengths carrying data packets destined for a customer's premises are propagated on a bundle of wavelengths labeled "λ 1-4 down". For purposes of the description herein, four wavelengths are shown for the down-